

**METHODS AND COMPOSITIONS  
FOR TREATING VASCULAR DEMENTIA**

**FIELD OF THE INVENTION**

[0001] The invention relates to compositions that treat vascular dementia and can be taken as dietary supplements or medication. The compositions comprise yeast cells obtainable by growth in electromagnetic fields with specific frequencies and field strengths.

**BACKGROUND OF THE INVENTION**

[0002] Vascular Dementia (VaD) is defined as the loss of cognitive function resulting from ischemic, ischemic-hypoxic, or hemorrhagic brain lesions as a result of cardiovascular diseases and cardiovascular pathologic changes. See, e.g., G. C. Roman, *Med. Clin. North. Am.*, 86, pp. 477-99 (2002). VaD is a chronic disorder and the symptoms of VaD include cognitive loss, headaches, insomnia and memory loss. VaD may be caused by multiple strokes (MID or poststroke dementia) but also by single strategic strokes, multiple lacunes, and hypoperfusive lesions such as border zone infarcts and ischemic periventricular leukoencephalopathy (Binswanger's disease). See, G. C. Roman, *supra*. In Asian countries such as China, Japan and Korea, VaD is observed in over 60% of patients with dementia. Primary and secondary prevention of stroke and cardiovascular disease decreases the burden of VaD.

[0003] Treatment of VaD involves control of risk factors (i.e., hypertension, diabetes, smoking, hyperfibrinogenemia, hyperhomocystinemia, orthostatic

hypotension, cardiac arrhythmias). See, G. C. Roman, *supra*. Researchers have also investigated whether hormone replacement therapy and estrogen replacement therapy could delay the onset of dementia in women. See, E. Hogervorst et al., Cochrane Database Syst. Rev., 3, CD003799 (2002). Although there has been  
5 evidence that aspirin is widely prescribed for VaD, there is very limited evidence that aspirin is effective in treating patients with VaD. See, P.S. Williams et al., Cochrane Database Syst. Rev., 2, CD001296 (2000). Nimodipine has been implicated as a drug demonstrating short-term benefits in VaD patients, but has not been justified as a long-term anti-dementia drug. See, J. M. Lopez-Arrieta and J.  
10 Birks, Cochrane Database Syst. Rev., 3, CD000147 (2002). Further, clinical efficacy data of piracetam does not support the use of this drug in the treatment of dementia or cognitive impairment. L. Flicker and G. Grimley Evans, Cochrane Database Syst. Rev., 2, CD001011 (2001). Thus, an agent that is effective in treating VaD is highly desired in the market.

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#### **SUMMMARY OF THE INVENTION**

[0004] This invention is based on the discovery that certain yeast cells can be activated by electromagnetic fields having specific frequencies and field strengths to produce substances that assist in treating vascular dementia. The composition of this invention can be taken as dietary supplements in the form of  
20 health drinks or pills.

[0005] This invention embraces a composition comprising a plurality of yeast cells that have been cultured in the presence of an alternating electric field having a frequency in the range of about 10280 to 13000 MHz and a field strength in the range of about 200 to 500 mV/cm, as compared to yeast cells not having  
25 been so cultured. In one embodiment, the frequency of the culturing is in the range of about 10280 to 10400 MHz, 12320 to 12380 MHz or 12950 to 13000 MHz. In one embodiment, the field strength is in the range of about 200 to 400 mV/cm. The yeast cells are cultured in the alternating electric field for a period of time sufficient to increase the capability of said plurality of yeast cells to improve the  
30 memory of a mammal with vascular dementia, as compared to unactivated yeast

- cells. Preferably, the mammal is human. In one embodiment, the vascular dementia was induced by cerebral ischemia. In another embodiment, the vascular dementia was induced by blockage of the middle cerebral artery. In one embodiment, the frequency and/or the field strength of the alternating electric field 5 can be altered within the aforementioned ranges during said period of time. In other words, the yeast cells can be exposed to a series of electromagnetic fields. An exemplary period of time is about 80-140 hours.
- [0006] Also included in this invention is a composition comprising a plurality of yeast cells that have been cultured under acidic conditions in an 10 alternating electric field having a frequency in the range of about 12950-13000 MHz and a field strength in the range of about 240 to 460 mV/cm (e.g., 240-260, 320-350, 360-390 or 420-460 mV/cm). In one embodiment, the yeast cells are exposed to a series of electromagnetic fields. An exemplary period of time is about 80-190 hours.
- 15 [0007] Included in this invention are also methods of making the above compositions and methods of treating vascular dementia.
- [0008] Yeast cells that can be included in this composition can all be derived from the China General Microbiological Culture Collection Center ("CGMCC") (China Committee for Culture Collection of Microorganisms, 20 Institute of Microbiology, Chinese Academy of Sciences, Haidian, P.O. BOX 2714, Beijing, 100080, China). Useful yeast species include, but are not limited to, *Schizosaccharomyces pombe*, *Saccharomyces sake*, *Saccharomyces uvarum*, *Saccharomyces rouxii*, *Saccharomyces carlsbergensis*, *Rhodotorula aurantiaca* and *Saccharomyces cerevisiae*. For instance, the yeast cells can be of the strain 25 *Saccharomyces cerevisiae* Hansen IFFI1340. In another embodiment, the yeast cells are from the strains selected from the group consisting of *Saccharomyces cerevisiae* Hansen AS 2.501, AS2.502, AS2.503, AS2.504, AS2.535, AS2.558, AS2.560, AS2.561 and AS2.562. Other useful yeast species are illustrated in Table 1.
- 30 [0009] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in

the art to which this invention belongs. Exemplary methods and materials are described below, although methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present invention. All publications and other references mentioned herein are incorporated by

5 reference in their entirety. In case of conflict, the present specification, including definitions, will control. The materials, methods, and examples are illustrative only and not intended to be limiting. Throughout this specification and claims, the word "comprise," or variations such as "comprises" or "comprising" will be understood to imply the inclusion of a stated integer or group of integers but not

10 the exclusion of any other integer or group of integers.

[0010] Other features and advantages of the invention will be apparent from the following detailed description, and from the claims.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0011] Fig. 1 is a schematic diagram showing an exemplary apparatus for activating yeast cells using electromagnetic fields. 1: yeast culture; 2: container; 3: power supply.

[0012] Fig. 2 is a schematic diagram showing an exemplary apparatus for making yeast compositions of the invention. The apparatus comprises a signal generator (such as models 83721B and 83741A manufactured by HP) and

20 interconnected containers A, B and C.

#### **DETAILED DESCRIPTION OF THE INVENTION**

[0013] This invention is based on the discovery that certain yeast strains can be activated by electromagnetic fields ("EMF") having specific frequencies and field strengths to produce agents useful in improving the memory of a mammal with vascular dementia. Yeast compositions containing activated yeast cells can be used as medication, or as dietary supplements in the form of, e.g., health drinks or dietary pills.

[0014] Since the activated yeast cells contained in these yeast compositions have been cultured to endure acidic conditions of pH 2.5-4.2, the compositions are

stable in the stomach and can pass on to the intestines. Once in the intestines, the yeast cells are ruptured by various digestive enzymes, and the agents useful in improving memory are released and readily absorbed.

### **I. Yeast Strains Useful in the Invention**

- 5 [0015] The types of yeasts useful in this invention include, but are not limited to, yeasts of the genera *Saccharomyces*, *Schizosaccharomyces* and *Rhodotorula*.
- [0016] Exemplary species within the above-listed genera include, but are not limited to, the species illustrated in Table 1. Yeast strains useful in this
- 10 invention can be obtained from laboratory cultures, or from publically accessible culture depositories, such as CGMCC and the American Type Culture Collection, 10801 University Boulevard, Manassas, VA 20110-2209. Non-limiting examples of useful strains (with the accession numbers of CGMCC) are illustrated in Table 1. In general, yeast strains preferred in this invention are those used for
- 15 fermentation in the food and wine industries. As a result, compositions containing these yeast cells are safe for human consumption. The preparation of the yeast compositions of this invention is not limited to starting with a pure strain of yeast. A yeast composition of the invention may be produced by culturing a mixture of yeast cells of different species or strains.

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Table 1 Exemplary Yeast Strains

<i>Saccharomyces cerevisiae Hansen</i>				
ACCC2034	ACCC2035	ACCC2036	ACCC2037	ACCC2038
ACCC2039	ACCC2040	ACCC2041	ACCC2042	AS2. 1
AS2. 4	AS2. 11	AS2. 14	AS2. 16	AS2. 56
25 AS2. 69	AS2. 70	AS2. 93	AS2. 98	AS2. 101
AS2. 109	AS2. 110	AS2. 112	AS2. 139	AS2. 173
AS2. 174	AS2. 182	AS2. 196	AS2. 242	AS2. 336
AS2. 346	AS2. 369	AS2. 374	AS2. 375	AS2. 379
AS2. 380	AS2. 382	AS2. 390	AS2. 393	AS2. 395

	AS2. 396	AS2. 397	AS2. 398	AS2. 399	AS2. 400
	AS2. 406	AS2. 408	AS2. 409	AS2. 413	AS2. 414
	AS2. 415	AS2. 416	AS2. 422	AS2. 423	AS2. 430
	AS2. 431	AS2. 432	AS2. 451	AS2. 452	AS2. 453
5	AS2. 458	AS2. 460	AS2. 463	AS2. 467	AS2. 486
	AS2. 501	AS2. 502	AS2. 503	AS2. 504	AS2. 516
	AS2. 535	AS2. 536	AS2. 558	AS2. 560	AS2. 561
	AS2. 562	AS2. 576	AS2. 593	AS2. 594	AS2. 614
	AS2. 620	AS2. 628	AS2. 631	AS2. 666	AS2. 982
10	AS2. 1190	AS2. 1364	AS2. 1396	IFFI1001	IFFI1002
	IFFI1005	IFFI1006	IFFI1008	IFFI1009	IFFI1010
	IFFI1012	IFFI1021	IFFI1027	IFFI1037	IFFI1042
	IFFI1043	IFFI1045	IFFI1048	IFFI1049	IFFI1050
	IFFI1052	IFFI1059	IFFI1060	IFFI1062	IFFI1063
15	IFFI1202	IFFI1203	IFFI1206	IFFI1209	IFFI1210
	IFFI1211	IFFI1212	IFFI1213	IFFI1214	IFFI1215
	IFFI1220	IFFI1221	IFFI1224	IFFI1247	IFFI1248
	IFFI1251	IFFI1270	IFFI1277	IFFI1287	IFFI1289
	IFFI1290	IFFI1291	IFFI1292	IFFI1293	IFFI1297
20	IFFI1300	IFFI1301	IFFI1302	IFFI1307	IFFI1308
	IFFI1309	IFFI1310	IFFI1311	IFFI1331	IFFI1335
	IFFI1336	IFFI1337	IFFI1338	IFFI1339	IFFI1340
	IFFI1345	IFFI1348	IFFI1396	IFFI1397	IFFI1399
	IFFI1411	IFFI1413	IFFI1441	IFFI1443	
25	<i>Saccharomyces cerevisiae</i> Hansen Var. ellipsoideus (Hansen) Dekker				
	ACCC2043	AS2.2	AS2.3	AS2.8	AS2.53
	AS2.163	AS2.168	AS2.483	AS2.541	AS2.559
	AS2.606	AS2.607	AS2.611	AS2.612	
	<i>Saccharomyces chevalieri</i> Guilliermond				
30	AS2.131	AS2.213			

				<i>Saccharomyces delbrueckii</i>
		AS2.285		
				<i>Saccharomyces delbrueckii</i> Lindner ver. <i>mongolicus</i> (Saito) Lodder et van Rij
		AS2.209	AS2.1157	
5				<i>Saccharomyces exiguous</i> Hansen
		AS2.349	AS2.1158	
				<i>Saccharomyces fermentati</i> (Saito) Lodder et van Rij
		AS2.286	AS2.343	
				<i>Saccharomyces logos</i> van laer et Denamur ex Jorgensen
10		AS2.156	AS2.327	AS2.335
				<i>Saccharomyces mellis</i> (Fabian et Quinet) Lodder et kreger van Rij
		AS2.195		
				<i>Saccharomyces mellis</i> Microellipsoides Osterwalder
		AS2.699		
15				<i>Saccharomyces oviformis</i> Osteralder
		AS2.100		
				<i>Saccharomyces rosei</i> (Guilliermond) Lodder et Kreger van Rij
		AS2.287		
				<i>Saccharomyces rouxii</i> Boutroux
20		AS2.178	AS2.180	AS2.370 AS2.371
				<i>Saccharomyces sake</i> Yabe
		ACCC2045		
				<i>Candida arborea</i>
		AS2.566		
25				<i>Candida lambica</i> (Lindner et Genoud) van. Uden et Buckley
		AS2.1182		
				<i>Candida krusei</i> (Castellani) Berkhout
		AS2.1045		

	<i>Candida lipolytica</i> (Harrison) Diddens et Lodder				
	AS2.1207	AS2.1216	AS2.1220	AS2.1379	AS2.1398
	AS2.1399	AS2.1400			
5	<i>Candida parapsilosis</i> (Ashford) Langeron et Talice Var. <i>intermedia</i> Van Rij et Verona				
	AS2.491				
	<i>Candida parapsilosis</i> (Ashford) Langeron et Talice				
	AS2.590				
10	<i>Candida pulcherrima</i> (Lindner) Windisch				
	AS2.492				
	<i>Candida rugousa</i> (Anderson) Diddens et Lodder				
	AS2.511	AS2.1367	AS2.1369	AS2.1372	AS2.1373
	AS2.1377	AS2.1378	AS2.1384		
15	<i>Candida tropicalis</i> (Castellani) Berkhout				
	ACCC2004	ACCC2005	ACCC2006	AS2.164	AS2.402
	AS2.564	AS2.565	AS2.567	AS2.568	AS2.617
	AS2.637	AS2.1387	AS2.1397		
	<i>Candida utilis</i> Henneberg Lodder et Kreger Van Rij				
	AS2.120	AS2.281	AS2.1180		
20	<i>Crebrothecium ashbyii</i> (Guilliermond)				
	Routein ( <i>Eremothecium ashbyii</i> Guilliermond)				
	AS2.481	AS2.482	AS2.1197		
	<i>Geotrichum candidum</i> Link				
	ACCC2016	AS2.361	AS2.498	AS2.616	AS2.1035
25	AS2.1062	AS2.1080	AS2.1132	AS2.1175	AS2.1183

	<i>Hansenula anomala</i> (Hansen) H et P sydow				
5	ACCC2018	AS2.294	AS2.295	AS2.296	AS2.297
	AS2.298	AS2.299	AS2.300	AS2.302	AS2.338
	AS2.339	AS2.340	AS2.341	AS2.470	AS2.592
	AS2.641	AS2.642	AS2.782	AS2.635	AS2.794
	<i>Hansenula arabitolgens</i> Fang				
	AS2.887				
	<i>Hansenula jadinii</i> (A. et R Sartory Weill et Meyer) Wickerham				
10	ACCC2019				
	<i>Hansenula saturnus</i> (Klocker) H et P sydow				
	ACCC2020				
	<i>Hansenula schneggii</i> (Weber ) Dekker				
	AS2.304				
	<i>Hansenula subpelliculosa</i> Bedford				
15	AS2.740	AS2.760	AS2.761	AS2.770	AS2.783
	AS2.790	AS2.798	AS2.866		
	<i>Kloeckera apiculata</i> (Reess emend. Klocker) Janke				
	ACCC2022	ACCC2023	AS2.197	AS2.496	AS2.714
	ACCC2021	AS2.711			
20	<i>Lipomycess starkeyi</i> Lodder et van Rij				
	AS2.1390	ACCC2024			
	<i>Pichia farinosa</i> (Lindner) Hansen				
	ACCC2025	ACCC2026	AS2.86	AS2.87	AS2.705
	AS2.803				
25	<i>Pichia membranaefaciens</i> Hansen				
	ACCC2027	AS2.89	AS2.661	AS2.1039	
	<i>Rhodosporidium toruloides</i> Banno				
	ACCC2028				

	<i>Rhodotorula glutinis</i> (Fresenius) Harrison				
	AS2.2029	AS2.280	ACCC2030	AS2.102	AS2.107
	AS2.278	AS2.499	AS2.694	AS2.703	AS2.704
	AS2.1146				
5	<i>Rhodotorula minuta</i> (Saito) Harrison				
	AS2.277				
	<i>Rhodotorula rubar</i> (Demme) Lodder				
	AS2.21	AS2.22	AS2.103	AS2.105	AS2.108
	AS2.140	AS2.166	AS2.167	AS2.272	AS2.279
10	AS2.282	ACCC2031			
	<i>Rhodotorula aurantiaca</i> (Saito) Lodder				
	AS2.102	AS2.107	AS2.278	AS2.499	AS2.694
	AS2.703	AS2.1146			
	<i>Saccharomyces carlsbergensis</i> Hansen				
15	AS2.113	ACCC2032	ACCC2033	AS2.312	AS2.116
	AS2.118	AS2.121	AS2.132	AS2.162	AS2.189
	AS2.200	AS2.216	AS2.265	AS2.377	AS2.417
	AS2.420	AS2.440	AS2.441	AS2.443	AS2.444
	AS2.459	AS2.595	AS2.605	AS2.638	AS2.742
20	AS2.745	AS2.748	AS2.1042		
	<i>Saccharomyces uvarum</i> Beijer				
	IFFI1023	IFFI1032	IFFI1036	IFFI1044	IFFI1072
	IFFI1205	IFFI1207			
	<i>Saccharomyces willianus</i> Saccardo				
25	AS2.5 AS2.7 AS2.119		AS2.152	AS2.293	
	AS2.381	AS2.392	AS2.434	AS2.614	AS2.1189
	<i>Saccharomyces</i> sp.				
	AS2.311				
	<i>Saccharomyces ludwigii</i> Hansen				
30	ACCC2044	AS2.243	AS2.508		

					<i>Saccharomyces sinenses</i> Yue
		AS2.1395			
					<i>Schizosaccharomyces octosporus</i> Beijerinck
	ACCC2046	AS2.1148			
5					<i>Schizosaccharomyces pombe</i> Lindner
	ACCC2047	ACCC2048	AS2.214	AS2.248	AS2.249
	AS2.255	AS2.257	AS2.259	AS2.260	AS2.274
	AS2.994	AS2.1043	AS2.1149	AS2.1178	IFFI1056
					<i>Sporobolomyces roseus</i> Kluyver et van Niel
10	ACCC2049	ACCC2050	AS2.19	AS2.962	AS2.1036
	ACCC2051	AS2.261	AS2.262		
					<i>Torulopsis candida</i> (Saito) Lodder
	AS2.270	ACCC2052			
					<i>Torulopsis famta</i> (Harrison) Lodder et van Rij
15	ACCC2053	AS2.685			
					<i>Torulopsis globosa</i> (Olson et Hammer) Lodder et van Rij
	ACCC2054	AS2.202			
					<i>Torulopsis inconspicua</i> Lodder et Kreger van Rij
	AS2.75				
20					<i>Trichosporon behrendii</i> Lodder et Kreger van Rij
	ACCC2056	AS2.1193			
					<i>Trichosporon capitatum</i> Diddens et Lodder
	ACCC2056	AS2.1385			
					<i>Trichosporon cutaneum</i> (de Beurm et al.) Ota
25	ACCC2057	AS2.25	AS2.570	AS2.571	AS2.1374
					<i>Wickerhamia fluorescens</i> (Soneda) Soneda
	ACCC2058	AS2.1388			

## **II. Application of Electromagnetic Fields**

- [0017] An electromagnetic field useful in this invention can be generated and applied by various means well known in the art. For instance, the EMF can be generated by applying an alternating electric field or an oscillating magnetic field.
- 5 [0018] Alternating electric fields can be applied to cell cultures through electrodes in direct contact with the culture medium, or through electromagnetic induction. See, e.g., Fig. 1. Relatively high electric fields in the medium can be generated using a method in which the electrodes are in contact with the medium. Care must be taken to prevent electrolysis at the electrodes from introducing
- 10 undesired ions into the culture and to prevent contact resistance, bubbles, or other features of electrolysis from dropping the field level below that intended. Electrodes should be matched to their environment, for example, using Ag-AgCl electrodes in solutions rich in chloride ions, and run at as low a voltage as possible. For general review, see Goodman et al., *Effects of EMF on Molecules and Cells*,
- 15 International Review of Cytology, A Survey of Cell Biology, Vol. 158, Academic Press, 1995.
- [0019] The EMFs useful in this invention can also be generated by applying an oscillating magnetic field. An oscillating magnetic field can be generated by oscillating electric currents going through Helmholtz coils. Such a magnetic field
- 20 in turn induces an electric field.
- [0020] The frequencies of EMFs useful in this invention range from about 10280 to 13000 MHz (e.g., 10280 to 10400, 12320 to 12380 and 12950 to 13000 MHz). Exemplary frequencies include 10300, 10312, 12348, 12963 and 12987 MHz. The field strength of the electric field useful in this invention ranges from
- 25 about 200 to 500 mV/cm (e.g., 240-260, 270-290 and 330-480 mV/cm). Exemplary field strengths include 256, 282, 332, 337, 343, 356, 367, 372, 382, 416, 435 and 461 mV/cm.
- [0021] When a series of EMFs are applied to a yeast culture, the yeast
- 30 culture can remain in the same container while the same set of EMF generator and emitters is used to change the frequency and/or field strength. The EMFs in the series can each have a different frequency or a different field strength; or a different

frequency and a different field strength. Such frequencies and field strengths are preferably within the above-described ranges. Although any practical number of EMFs can be used in a series, it may be preferred that the yeast culture be exposed to a total of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 or more EMFs in a series. In one embodiment, the yeast culture is exposed to a series of EMFs, wherein the frequency of the electric field is alternated in the range of about 10280 to 10400, 12320 to 12380 and 12950 to 13000 MHz.

[0022] Although the yeast cells can be activated after even a few hours of culturing in the presence of an EMF, it may be preferred that the compositions comprising activated yeast cells be allowed to multiply and grow in the presence of the EMF(s) for a total of 80-140, 90-136 and 80-190 hours.

[0023] Fig. 1 illustrates an exemplary apparatus for generating alternating electric fields. An electric field of a desired frequency and intensity can be generated by an AC source (3) capable of generating an alternating electric field, preferably in a sinusoidal wave form, in the frequency range of 5 to 20,000 MHz. Signal generators capable of generating signals with a narrower frequency range can also be used. If desired, a signal amplifier can also be used to increase the output. The culture container (2) can be made from a non-conductive material, e.g., glass, plastic or ceramic. The cable connecting the culture container (2) and the signal generator (3) is preferably a high frequency coaxial cable with a transmission frequency of at least 20 GHz. In one embodiment, the transmission frequency is 30 GHz.

[0024] The alternating electric field can be applied to the culture by a variety of means, including placing the yeast culture (1) in close proximity to the signal emitters such as a metal wire or tube capable of transmitting EMFs. The metal wire or tube can be made of red copper , and be placed inside the container (2), reaching as deep as 3-30 cm. For example, if the fluid in the container (2) has a depth of 15-20 cm, 20-30 cm, 30-50 cm, 50-70 cm, 70-100 cm, 100-150 cm or 150-200 cm, the metal wire can be 3-5 cm, 5-7 cm, 7-10 cm, 10-15 cm, 15-20 cm, 20-30 cm and 25-30 cm from the bottom of the container (2), respectively. The number of metal wires/tubes used can be from 1 to 10 (e.g., 2 to 3). It is

recommended, though not mandated, that for a culture having a volume up to 10 L, metal wires/tubes having a diameter of 0.5 to 2 mm be used. For a culture having a volume of 10-100 L, metal wires/tubes having a diameter of 3 to 5 mm can be used. For a culture having a volume of 100-1000 L, metal wires/tubes having a diameter of 6 to 15 mm can be used. For a culture having a volume greater than 1000 L, metal wires/tubes having a diameter of 20-25 mm can be used.

5 [0025] In one embodiment, the electric field is applied by electrodes submerged in the culture (1). In this embodiment, one of the electrodes can be a metal plate placed on the bottom of the container (2), and the other electrode can 10 comprise a plurality of electrode wires evenly distributed in the culture (1) so as to achieve even distribution of the electric field energy. The number of electrode wires used depends on the volume of the culture as well as the diameter of the wires.

### III. Culture Media

15 [0026] Culture media useful in this invention contain sources of nutrients that can be assimilated by yeast cells. Complex carbon-containing substances in a suitable form (e.g., carbohydrates such as sucrose, glucose, dextrose, maltose, starch, xylose; mannitol) can be the carbon sources for yeast cells. The exact quantity of the carbon sources can be adjusted in accordance with the other 20 ingredients of the medium. In general, the amount of carbon-containing substances varies between about 0.5% and 10% by weight of the medium, and preferably between about 1% and 5%, and most preferably between about 1.0-2.5%. These carbon sources can be used individually or in combination. Vitamins can also be added to the medium, for example, Vitamin D, Vitamin B<sub>12</sub>, Vitamin E or Vitamin 25 B<sub>6</sub>. Among the inorganic salts which can be added to a culture medium are the customary salts capable of yielding sodium, potassium, calcium, phosphate, sulfate, carbonate, and like ions. Non-limiting examples of nutrient inorganic salts are (NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub>, CaCO<sub>3</sub>, KH<sub>2</sub>PO<sub>4</sub>, K<sub>2</sub>HPO<sub>4</sub>, MgSO<sub>4</sub>, NaCl, and CaSO<sub>4</sub>.

### IV. Electromagnetic Activation of Yeast Cells

[0027] To activate or enhance the innate ability of yeast cells to improve memory, these cells can be cultured in an appropriate medium under sterile conditions at 20°C-35°C (e.g., 28-32°C) for a sufficient amount of time, e.g., 80-140, 90-136, 80-190 hours, in an alternating electric field or a series of alternating 5 electric fields as described above.

[0028] An exemplary set-up of the culture process is depicted in Fig. 1 (see above). An exemplary culture medium contains the following in per 1000 ml of sterile water: 6 g of sucrose, 12 g of mannitol, 70 µg of Vitamin D, 50 µg of Vitamin B<sub>12</sub>, 40 µg of Vitamin E, 90 µg of Vitamin B<sub>6</sub>, 50 ml of bovine serum, 10 0.20 g of KH<sub>2</sub>PO<sub>4</sub>, 0.25g of MgSO<sub>4</sub>•7H<sub>2</sub>O, 0.3 g of NaCl, 0.2 g of CaSO<sub>4</sub>•2H<sub>2</sub>O, 4.0 g of CaCO<sub>3</sub>•5H<sub>2</sub>O, 2.5 g of peptone. Yeast cells of the desired strains are then added to the culture medium to form a mixture containing 1x10<sup>8</sup> yeast cells per 1000 ml of culture medium. The yeast cells can be of any of the strains listed in Table 1. In one embodiment, the strain is *Saccharomyces cerevisiae* Hansen 15 IFFI1340. The mixture is then added to the apparatus of Fig. 1.

[0029] The activation process of the yeast cells involves the following steps: 1) maintaining the temperature of the activation apparatus at 20-35°C, (e.g., 28-32°C), culturing the yeast cells for 28 hours; 2) applying an electric field having a frequency of about 10300 MHz and a field strength of 240-260 mV/cm (e.g., 20 about 256 mV/cm) for 16 hours; 3) then applying an electric field having a frequency of about 10312 MHz and a field strength of 330-360 mV/cm (e.g., about 343 mV/cm) for 36 hours; 4) then applying an electric field having a frequency of about 12348 MHz and a field strength of 350-380 mV/cm (e.g., about 367 mV/cm) for 32 hours; 5) then applying an electric field having a frequency of about 12963 25 MHz and a field strength of 370-400 mV/cm (e.g., about 382 mV/cm) for 36 hours; 6) then applying an electric field having a frequency of about 12987 MHz and a field strength of 330-360 mV/cm (e.g., about 337 mV/cm) for 16 hours; and 7) finally lyophilizing the compositions comprising activated yeast cells to form a powder and storing the powder at 4°C. Preferably, the concentration of the 30 lyophilized yeast cells is more than 10<sup>10</sup> cells/g.

**V. Acclimatization of Yeast Cells To the Gastric Environment**

[0030] Because the yeast compositions of this invention must pass through the stomach before reaching the small intestine, where the effective components are released from these yeast cells, it is preferred that these yeast cells be cultured under acidic conditions to acclimatize the cells to the gastric juice. This acclimatization process results in better viability of the yeasts in the acidic gastric environment.

[0031] To achieve this, the yeast powder containing activated yeast cells can be mixed with a highly acidic acclimatizing culture medium at 10 g (containing more than  $10^{10}$  activated cells per gram) per 1000 ml. The yeast mixture is then cultured first in the presence of an alternating electric field having a frequency of about 12963 MHz and a field strength of 390-430 mV/cm (e.g., about 416 mV/cm) at about 28 to 32°C for 28-36 hours (e.g., about 32 hours). The resultant yeast cells are further incubated in the presence of an alternating electric field having a frequency of about 12987 MHz and a field strength of 340-370 mV/cm (e.g., about 356 mV/cm) at about 28 to 32°C for 16-28 hours (e.g., about 20 hours). The resulting acclimatized yeast cells are then dried and stored either in powder form ( $\geq 10^{10}$  cells/g) at room temperature or in vacuum at 0-4°C.

[0032] An exemplary acclimatizing culture medium is made by mixing 700 ml of fresh pig gastric juice and 300 ml of wild Chinese hawthorn extract. The pH of the acclimatizing culture medium is adjusted to 2.5 with 0.1 M hydrochloric acid and 0.2 M potassium biphthalate ( $C_6H_4(COOK)COOH$ ). The fresh pig gastric juice is prepared as follows. At about 4 months of age, newborn Holland white pigs are sacrificed, and the entire contents of their stomachs are retrieved and mixed with 2000 ml of water under sterile conditions. The mixture is then allowed to stand for 6 hours at 4°C under sterile conditions to precipitate food debris. To prepare the wild Chinese hawthorn extract, 500 g of fresh wild Chinese hawthorn is dried under sterile conditions to reduce the water content ( $\leq 8\%$ ). The dried fruit is then ground ( $\geq 20$  mesh) and added to 1500 ml of sterile water. The mixture is allowed to stand for 6 hours at 4°C under sterile conditions. The supernatant is collected to be used in the acclimatizing culture medium.

## VI. Manufacture of Yeast Compositions

- [0033] To prepare the yeast compositions of the invention, an apparatus depicted in Fig. 2 or an equivalent thereof can be used. This apparatus includes a first container (A), a second container (B), and a third container (C), each equipped with a pair of electrodes (4). One of the electrodes is a metal plate placed on the bottom of the containers, and the other electrode comprises a plurality of electrode wires evenly distributed in the space within the container to achieve even distribution of the electric field energy. All three pairs of electrodes are connected to a common signal generator.
- 10 [0034] The culture medium used for this purpose is a mixed fruit extract solution containing the following ingredients per 1000 L: 300 L of wild Chinese hawthorn extract, 300 L of jujube extract, 300 L of fruit extracts from *Schisandra chinensis Baill* (wu wei zi), and 100 L of soy bean extracts. To prepare hawthorn, jujube and wu wei zi extracts, the fresh fruits are washed and dried under sterile
- 15 conditions to reduce the water content to no higher than 8%. One hundred kilograms of the dried fruits are then ground ( $\geq 20$  mesh) and added to 400 L of sterile water. The mixtures are stirred under sterile conditions at room temperature for twelve hours, and then centrifuged at 1000 rpm to remove insoluble residues. To make the soy bean extract, fresh soy beans are washed and dried under sterile
- 20 conditions to reduce the water content to no higher than 8%. Thirty kilograms of dried soy beans are then ground into particles of no smaller than 20 mesh, and added to 130 L of sterile water. The mixture is stirred under sterile conditions at room temperature for twelve hours and centrifuged at 1000 rpm to remove insoluble residues. Once the mixed fruit extract solution is prepared, the solution
- 25 is sterilized at 121°C for 30 minutes, and cooled to 40 °C before use.
- [0035] One thousand grams of the activated yeast powder prepared as described above (Section V, *supra*) is added to 1000 L of the mixed fruit extract solution, and the yeast solution is transferred to the first container (A) shown in Fig. 2. The yeast cells are then cultured in the presence of an alternating electric
- 30 field having a frequency of about 12963 MHz and a field strength of about 420-460 mV/cm (e.g., about 435 mV/cm) at 28-32°C under sterile conditions for 32 hours.

The yeast cells are further incubated in an alternating electric field having a frequency of about 12987 MHz and a field strength of 270-290 mV/cm (e.g., about 282 mV/cm). The culturing continues for another 12 hours.

[0036] The yeast culture is then transferred from the first container (A) to 5 the second container (B) (if need be, a new batch of yeast culture can be started in the now available first container (A)), and subjected to an alternating electric field having a frequency of about 12963 MHz and a field strength of 400-420 mV/cm (e.g., about 416 mV/cm) for 24 hours. Subsequently the frequency and field strength of the electric field are changed to about 12987 MHz and 320-350 mV/cm 10 (e.g., about 332 mV/cm), respectively. The culturing continues for another 12 hours.

[0037] The yeast culture is then transferred from the second container (B) to the third container (C), and subjected to an alternating electric field having a frequency of about 12963 MHz and a field strength of 360-390 mV/cm (e.g., about 15 372 mV/cm) for 24 hours. Subsequently the frequency and field strength of the electric field are changed to about 12987 MHz and 240-260 mV/cm (e.g., about 256 mV/cm), respectively. The culturing continues for another 12 hours.

[0038] The yeast culture from the third container (C) can then be packaged into vacuum sealed bottles of 30-50 ml or 100 ml for use as a dietary supplement, 20 e.g., health drinks, or medication in the form of pills, powder, etc. The dietary supplement can be taken 3-4 times daily at 30-50 ml each time for a period of three months (10-30 minutes before meals and at bedtime). If desired, the final yeast culture can also be dried within 24 hours and stored in powder form.

[0039] In one embodiment, the compositions of the invention can also be 25 administered intravenously or peritoneally in the form of a sterile injectable preparation. Such a sterile preparation is prepared as follows. A sterilized health drink composition is first treated under ultrasound ( $\geq 18,000$  Hz) for 10 minutes and then centrifuged at 4355 rpm for another 10 minutes. The resulting supernatant is adjusted to pH 7.2-7.4 using 1 M NaOH and subsequently filtered 30 through a membrane (0.22  $\mu$ m for intravenous injection and 0.45  $\mu$ m for peritoneal

injection) under sterile conditions. The resulting sterile preparation is submerged in a 35-38 °C water bath for 30 minutes before use.

[0040] The yeast compositions of the present invention are derived from yeasts used in food and pharmaceutical industries. The yeast compositions are thus 5 devoid of side effects associated with many pharmaceutical compounds.

[0041] In other embodiments, the compositions of the invention may also be formulated with pharmaceutically acceptable carriers to be orally administered in any orally acceptable dosage form including, but not limited to, capsules, tablets, suspensions or solutions.

10 **Examples**

[0042] The following examples are meant to illustrate the methods and materials of the present invention. Suitable modifications and adaptations of the described conditions and parameters which are obvious to those skilled in the art are within the spirit and scope of the present invention.

15 [0043] The activated yeast compositions used in the following experiments were prepared as described above, using *Saccharomyces cerevisiae* Hansen IFFI1340 cultured in the presence of an alternating electric field having the electric field frequency and field strength exemplified in the parentheses following the recommended ranges. Control yeast compositions were those prepared in the same 20 manner except that the yeast cells were cultured in the absence of EMFs. Unless otherwise indicated, all yeast compositions and the corresponding controls were administered to the animals by intragastric feeding.

**Example 1: Effects on Rats with VaD induced by cerebral ischemia**

[0044] A large number of clinical studies have shown that blockage in the 25 artery or vein can reduce the blood flow in the brain, thereby inducing cerebral ischemia. When under ischemic conditions for only a few minutes, brain cells can be severely damaged, leading to stroke or dementia and even death. Blockage in the arteria carotis is a major cause in cerebral ischemia. A goal of the treatment is to help the damaged brain cells gradually recover.

[0045] In this experiment, VaD is induced by ligation of the common artery on both sides of the neck for 4-12 minutes (the duration depends on the blood flow), which results in memory loss in rats. The change in memory of the rats after administering the activated yeast composition is monitored. The rat VaD model  
5 closely resembles human VaD.

[0046] Male Wistar rats that were 4-6 months old, weighing 180-200 g were provided by the Chinese Academy of Medical Sciences. Anesthesia of 100 healthy rats was performed by administering abdominally 35 mg/kg (body weight) of chloral hydrate. Then, the necks of the rats were cleaved in the center. Twelve rats  
10 were selected for the positive control group (CK1 group), of which the cleaved skin was sealed, and  $2 \times 10^4$  unit/kg (body weight) of penicillin was injected into the buttocks of the rats to prevent infection. For the rest of the rats, the common artery on each side was separated, and clamped to control 50% of the blood flow. After 10 minutes, the clamp was removed and the blood flow in the artery recovered to  
15 normal conditions. Then, the cleaved skin of the rats was sealed, and  $2 \times 10^4$  unit/kg (body weight) of penicillin was injected into the buttocks of the rats to prevent infection.

[0047] The rats were fed for two days, and the memory of the rats were monitored by using the water maze method. Rats that exceeded 85 seconds in  
20 completing the maze were selected. The selected rats were divided into three groups of 12 each, the test group (AY), the control yeast group (NY) and the saline control group (CK2).

[0048] Each rat in groups AY, NY, CK2 and CK1 was administered twice daily 1 ml of the activated yeast composition, the control yeast composition and  
25 saline (for both CK2 and CK1), respectively for 21 days. The rats were monitored on Day 7, 14 and 21 for the time required to complete the maze. The results are shown in Table 2.

Table 2

Group	Time for completion of maze before treatment (seconds) ( $\bar{x} \pm SD$ )	Time for completion of maze on Day 7 (seconds) ( $\bar{x} \pm SD$ )	Time for completion of maze on Day 14 (seconds) ( $\bar{x} \pm SD$ )	Time for completion of maze on Day 21 (seconds) ( $\bar{x} \pm SD$ )	
5	AY	109.3 ± 11.7	82.5 ± 9.2	61.7 ± 7.4	52.4 ± 6.6
	NY	107.4 ± 11.2	104.8 ± 10.3	103.2 ± 10.8	103.7 ± 11.4
	CK2	108.7 ± 11.5	106.6 ± 9.7	104.3 ± 9.2	105.5 ± 11.2
	CK1	58.8 ± 7.2	51.6 ± 6.8	50.6 ± 6.2	50.7 ± 6.4

[0049] The above experiment shows that compared to the groups treated with unactivated yeast composition (NY) or saline (CK2), the group treated with activated yeast composition (AY) demonstrates significant recovery of memory after 7 days, 14 days and 21 days of treatment. On Day 21, the memory of the rats is comparable to those of the rats in the positive control group (CK1).

Example 2: Effects on VaD induced by blockage of the middle cerebral artery

[0050] In this experiment, paraffin oil is injected into the middle cerebral artery of rats. The paraffin oil mimicks the microparticles of thrombus and induces blockage of the blood vessel, leading to VaD in the rats. The VaD observed in the rat model is similar to that observed in humans. Through treatment, damaged brain cells recover, and the memory is improved. In this experiment, the Morris maze method was used to record the change in memory after treatment.

[0051] Male Sprague-Dawley rats that were 5-7 months old, weighing 220-250 g were provided by the Chinese Medical Science Academy. Anesthesia of 80 healthy rats was performed by administering abdominally 35 mg/kg (body weight) of soluble phenobarbital. Then, the necks of the rats were cleaved in the center. Fifteen rats were selected for the positive control group (CK1). The middle cerebral artery of these rats were slowly injected with 20  $\mu$ l/kg (body weight) of

saline for 10-15 minutes. For the rest of the rats, paraffin oil was slowly injected into the middle cerebral artery for 10-15 minutes at 20 µl/kg (body weight). The paraffin oil was sterilized at 121°C and cooled to 35 to 38°C before use. Then, the cleaved skin of the rats was sealed, and 2x10<sup>4</sup> unit/kg (body weight) of penicillin 5 was injected into the buttocks of the rats to prevent infection.

[0052] The rats were fed for ten days, and the memory of the rats were monitored by the Morris maze method on Day 11. Rats that exceeded 100 seconds in locating the safety zone were selected. The selected rats were divided into three groups of 15 each, the test group (AY), the control yeast group (NY) and the saline 10 control group (CK2).

[0053] Each rat in groups AY, NY, CK2 and CK1 was administered twice daily 1 ml of the activated yeast composition, the control yeast composition and saline (for both CK2 and CK1), respectively for 21 days. The rats were monitored on Day 7, 14 and 21 for the time required to locate the safety zone. The results are 15 shown in Table 3.

Table 3

Group	Time for locating the safety zone before treatment (seconds) (x±SD)	Time for locating the safety zone on Day 7 (seconds) (x±SD)	Time for locating the safety zone on Day 14 (seconds) (x±SD)	Time for locating the safety zone on Day 21 (seconds) (x±SD)
AY	146.4 ± 17.8	63.6 ± 9.7	32.6 ± 6.2	18.4 ± 3.6
NY	144.7 ± 18.2	138.2 ± 17.9	127.4 ± 16.4	129.3 ± 17.3
CK2	141.8 ± 16.8	133.4 ± 18.2	121.3 ± 19.7	130.2 ± 16.5
CK1	58.8 ± 7.2	51.6 ± 6.8	50.6 ± 6.2	50.7 ± 6.4

[0054] The above experiment shows that compared to the groups treated with unactivated yeast composition (NY) or saline (CK2), the group treated with activated yeast composition (AY) demonstrates significant recovery of memory 25 after 7 days, 14 days and 21 days of treatment. The group treated with unactivated yeast composition does not demonstrate any effect on the rats compared to the

saline control group. On Day 21, the memory of the rats is even better than that of the rats in the positive control group (CK1). Thus, the activated yeast composition helps rats with vascular dementia recover their memory.

[0055] While a number of embodiments of this invention have been set forth, it is apparent that the basic constructions may be altered to provide other embodiments which utilize the compositions and methods of this invention.